

SUB A1

We claim:

2 ~~A method of publishing relational data as XML, comprising the method steps of:~~

3 ~~mapping a number of relational database tables to a number of virtual XML~~

4 ~~documents;~~

5 ~~issuing XML queries over said virtual XML documents;~~

6 ~~parsing said XML queries;~~

7 ~~transforming said XML queries into a language-neutral intermediate~~

8 ~~representation;~~

9 ~~rewriting said language-neutral intermediate representation into an equivalent~~

10 ~~form easily translated into an SQL query;~~

11 ~~translating said equivalent form into an SQL query over said relational database~~

12 ~~tables and into tagging instructions passed to a tagger;~~

13 ~~executing said SQL query to produce SQL query results passed to said tagger;~~

14 ~~and~~

15 ~~generating XML output using said SQL query results and said tagging~~

16 ~~instructions.~~

- 1 2. The method of claim 1 wherein said method operates over a distributed computing
- 2 network.

- 1 3. The method of claim 2 wherein said method operates over the Internet.

- 1 4. The method of claim 1 wherein said mapping step operates recursively.
- 1 5. The method of claim 1 wherein said mapping step operates manually.
- 1 6. The method of claim 1 wherein said mapping step maps said relational database
2 tables to said virtual XML documents in a one-to-one manner.
- 1 7. The method of claim 1 wherein said language-neutral intermediate representation
2 includes a sequence of operations describing:
3 how to select and relate data from said relational database tables; and
4 how to construct and group new XML elements from data bindings.
- 1 8. The method of claim 7 wherein said transforming step operates on at least one said
2 relational database table and produces at least one output table.
- 1 9. The method of claim 7 wherein said operations include BIND operations.
- 1 10. The method of claim 7 wherein said operations include SELECT operations.
- 1 11. The method of claim 7 wherein said operations include CONSTRUCT operations.

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- 1 12. The method of claim 7 wherein said operations include JOIN operations.
 - 1 13. The method of claim 7 wherein said operations include GROUP operations.
 - 1 14. The method of claim 7 wherein said operations include NEST operations.
 - 1 15. The method of claim 1 wherein said rewriting step includes the further steps of:
 - 2 eliminating both S and B whenever S is followed by a BIND operation B, where
 - 3 S denotes the sequence of CONSTRUCT, GROUP, and CONSTRUCT
 - 4 operations following a table access for a default view of a table T,
 - 5 leaving just the table access for T; and
 - 6 replacing N by a JOIN operation, followed by S and a new GROUP operation
 - 7 which performs the child grouping that was previously done by N, where
 - 8 N denotes a NEST operation and S denotes any sequence of
 - 9 CONSTRUCT and GROUP operations for the child input of N.
 - 1 16. The method of claim 1 wherein said rewriting step may operate repeatedly for
 - 2 deeper levels of nesting.
 - 1 17. The method of claim 1 wherein said tagger operates outside an RDBMS.

1 18. The method of claim 7 wherein said operations describing how to select and relate
2 data are translated into an SQL query that establishes selection criteria and
3 required relationships among data.

1 19. The method of claim 7 wherein said operations describing how to construct and
2 group new XML elements are translated into said tagger instructions.

1 20. The method of claim 19 wherein said operations are reordered to be performed last.

1 21. The method of claim 19 wherein said language-neutral intermediate representation
2 serves as said tagging instructions.

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- 1 22. A system for publishing relational data as XML, comprising:
- 2 a schema mapper for mapping a number of relational database tables to a
- 3 number of virtual XML documents;
- 4 an XML-QL engine for issuing XML queries over said virtual XML documents;
- 5 a parser for parsing said XML queries and for transforming said XML queries
- 6 into a language-neutral intermediate representation;
- 7 a rewrite engine for rewriting said intermediate representation into an equivalent
- 8 form easily translated into an SQL query;
- 9 a translator for translating said equivalent form into an SQL query over said
- 10 relational database tables and into tagging instructions;
- 11 an RDBMS for executing said SQL query to produce SQL query results; and
- 12 a tagger for generating XML output using said SQL query results and said
- 13 tagging instructions.
- 1 23. The system of claim 22 wherein said system operates over a distributed computing
- 2 network.
- 1 24. The system of claim 23 wherein said system operates over the Internet.
- 1 25. The system of claim 22 wherein said schema mapper operates recursively.

- 1 26. The system of claim 22 wherein said schema mapper operates manually.
- 1 27. The system of claim 22 wherein said schema mapper maps said relational database
2 tables to said virtual XML documents in a one-to-one manner.
- 1 28. The system of claim 22 wherein said language-neutral intermediate representation
2 includes commands controlling how said system:
3 selects and relates data from said relational database tables; and.
4 constructs and groups new XML elements from data bindings.
- 1 29. The system of claim 28 wherein said parser operates on at least one said relational
2 database table and produces at least one output table.
- 1 30. The system of claim 28 wherein said system performs BIND operations.
- 1 31. The system of claim 28 wherein said system performs SELECT operations.
- 1 32. The system of claim 28 wherein said system performs CONSTRUCT operations.
- 1 33. The system of claim 28 wherein said system performs JOIN operations.

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- 1 34. The system of claim 28 wherein said system performs GROUP operations.
- 1 35. The system of claim 28 wherein said system performs NEST operations.
- 1 36. The system of claim 22 wherein said rewrite engine:
- 2 eliminates both S and B whenever S is followed by a BIND operation B, where
- 3 S denotes the sequence of CONSTRUCT, GROUP, and CONSTRUCT
- 4 operations following a table access for a default view of a table T,
- 5 leaving just the table access for T; and
- 6 replaces N by a JOIN operation, followed by S and a new GROUP operation
- 7 which performs the child grouping that was previously done by N, where
- 8 N denotes a NEST operation and S denotes any sequence of
- 9 CONSTRUCT and GROUP operations for the child input of N.
- 1 37. The system of claim 22 wherein said rewrite engine may operate repeatedly for
- 2 deeper levels of nesting.
- 1 38. The system of claim 22 wherein said tagger operates outside an RDBMS.

1 39. The system of claim 28 wherein said system translates commands describing how
2 to select and relate data into an SQL query that establishes selection criteria and
3 required relationships among data.

1 40. The system of claim 28 wherein said system translates commands describing how
2 to construct and group new XML elements into said tagger instructions.

1 41. The system of claim 40 wherein said commands are reordered to be performed last.

1 42. The system of claim 40 wherein said language-neutral intermediate representation
2 serves as said tagging instructions.

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1 43. A system for publishing relational data as XML, comprising:

2 means for mapping a number of relational database tables to a number of virtual

3 XML documents;

4 means for issuing XML queries over said virtual XML documents;

5 means for parsing said XML queries and for transforming said XML queries

6 into a language-neutral intermediate representation;

7 means for rewriting said intermediate representation into an equivalent form

8 easily translated into an SQL query;

9 means for translating said equivalent form into an SQL query over said

10 relational database tables and into tagging instructions;

11 means for executing said SQL query to produce SQL query results; and

12 means for generating XML output using said SQL query results and said

13 tagging instructions.

1 44. A computer program product comprising a machine-readable medium including
2 machine-executable instructions therein for publishing relational data as XML
3 comprising the steps of:
4 mapping a number of relational database tables to a number of virtual XML
5 documents;
6 issuing XML queries over said virtual XML documents;
7 parsing said XML queries;
8 transforming said XML queries into a language-neutral intermediate
9 representation;
10 rewriting said language-neutral intermediate representation into an equivalent
11 form easily translated into an SQL query;
12 translating said equivalent form into an SQL query over said relational database
13 tables and into tagging instructions passed to a tagger;
14 executing said SQL query to produce SQL query results passed to said tagger;
15 and
16 generating XML output using said SQL query results and said tagging
17 instructions.

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